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**Solving the Mine Countermeasures
Problem: A Matter of Focus and Priority**

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This document reviews mine countermeasure operations and how they impact on current national security and national military strategies as well as service doctrine. It recognizes that shortfalls in dealing with sea mines still exist and recommends where resources should be focused in order to tackle the most serious challenges facing future naval operations.

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SOLVING THE MINE COUNTERMEASURES PROBLEM: A MATTER OF FOCUS AND PRIORITY

...when you can't go where you want to, when you want to, you haven't got command of the sea. And command of the sea is a rockbottom foundation for all our war plans. We've been plenty submarine-conscious and air-conscious. Now we're going to start getting mine-conscious—beginning last week.

Admiral Forrest Sherman, USN
Chief of Naval Operations
October 1950

Mine warfare is neither more nor less important than any other major category of naval warfare. The problem with mine warfare, particularly mine countermeasures, however, is that it has not received the sustained attention that other warfare areas have, despite the fact that it has been, and continues to be, a critical enabling factor in the projection of effective naval expeditionary power throughout the world's littoral regions.

United States naval history is replete with definitive examples, dating from the American Civil War, of how superior naval power can be thwarted by nations with little or no navy, employing relatively cheap, unsophisticated mines.¹ Mine warfare lessons learned from the 1991 Gulf War are essentially the same lessons learned from the Civil War, the Spanish-American War, both World Wars, the Korean War, the Vietnam War and the 1987 Iran-Iraq "Tanker War." Yogi Berra's "deja vu all over again" is particularly apropos to U.S. mine warfare efforts.

¹ For an excellent historical reference see: Tamara Moser Melia, *"Damn the Torpedoes": A short History of U.S. Naval Mine Countermeasures, 1777 - 1991* (Washington D.C.: Naval Historical Center, 1991).

Unlike other naval warfare specialties, submarine warfare for example, mine warfare has been unable to translate threat identification and lessons learned into long-term programmatic counter-threat solutions. From a strictly objective point of view, it is difficult to understand how one specific warfare area could suffer such consistent, pandemic organizational myopia, for well over a century.

The Naval Service, however, consists of people, and people have preferences. Sailors prefer aircraft carriers, submarines and surface combatants. Marines like armored vehicles, amphibious ships and aircraft. Both have treated mine countermeasures assets as unwanted cousins mainly because mine warfare has no "bang appeal."² Limited budgets always make choices difficult, and parochialism often blurs objectivity.

As a general rule, naval officers have never liked mines and therefore have never paid much attention to them or the ships and technology needed to counter them. Mines were, and continue to be, the weapon of choice of the weak; a dastardly form of warfare. The United States Navy has never considered itself weak, therefore it has never been truly interested in mine warfare. Although usually taken slightly out of context, Rear Admiral David G. Farragut apparently expressed his disdain for mines (then called torpedoes) in Mobile Bay in 1864 ("Damn the torpedoes. . .") and the Navy has assumed that attitude ever since.

To make matters worse, those few naval officers who study and understand mine warfare have developed a kind of specialized vocabulary that only mine warfare "insiders" truly comprehend, making it even easier (and more likely) for most everyone else to ignore

² Gregory K. Hartman with Scott C. Truver, *Weapons That Wait, Mine Warfare in the U.S. Navy*, Updated Edition (Annapolis, MD: Naval Institute Press, 1991), p. 6.

the entire, distasteful subject. The problem, however, is much larger than the mine warfare community itself. It is a national problem, requiring national interest and assets to solve.

In an effort to expand sustained interest beyond the mine warfare community, this paper focuses attention on the direct link between national security priorities and the mine warfare/mine countermeasures problem. The first step is to identify current national security and naval priorities which could be directly impacted by the world-wide mine threat. The next step is to examine mines and their employment to determine where, and under what circumstances they pose the greatest threat to priorities identified in step one. Lastly, we must "peel the mine warfare onion" and highlight those specific areas where known deficiencies overlap with identified threats to national priorities. Simply put, some parts of mine warfare are more important than others, and we cannot afford the luxury of **not** prioritizing and focusing on the heart of the problem.

Mine warfare is not the only item on the list of naval priorities, or even perhaps, the number one item on the list, but it should occupy a much higher position than it has or does. By logically and objectively tracing the links between specific areas of mine warfare and essential naval missions required to support national security goals, priorities can be changed and the mine warfare "deja vu" cycle broken. As with air, surface and submarine warfare, once the correct priority and focus is established, the problem can get solved.

ESTABLISHING PRIORITIES

Few tasks during peacetime are more difficult than trying to determine what capabilities will be required to win the next war. Leading U.S. political and military

thinkers have dedicated much time and effort to this task since the surprise ending of the Cold War. The result has been a substantial shift in national and military priorities articulated in documents such as the *National Security Strategy*, the *National Military Strategy*, the Secretary of Defense's 1993 *Bottom-Up Review: Forces for a New Era*, the 1995 congressionally-mandated *Directions for Defense, Report of the Commission on Roles and Missions of the Armed Forces*, the Secretary of the Navy/Chief of Naval Operations/Commandant of the Marine Corps white papers . . . *From the Sea* and *Forward . . . From the Sea*, *Naval Doctrine Publication 1*, and the Marine Corps' *Operational Maneuver From the Sea*. In each case, the centerpiece of naval capability is power projection throughout the littoral regions of the world.

In order to effectively shape, balance, train and equip a military force, particularly in an era of declining budgets, political and military leaders must make critical decisions about which forces will most likely be called upon to do in the future. For all of America's armed forces, roles and missions associated with national survival must remain the highest priority. Procurement of strategic weapons platforms such as the B-2 bomber and the *Trident* submarine are certainly in a different category than converting the LPH *Inchon* to a mine countermeasures (MCM) command ship. Tracing priorities, however, from the current *National Security Strategy* through the *National Military Strategy* down through definitive naval policy documents, it becomes painfully obvious that certain areas within MCM are still receiving far less attention than objective consideration dictates.

National Security Strategy

Protecting our nation's security—our people, our territory and our way of life—is my Administration's foremost mission and constitutional duty.

President William J. Clinton³

Protection of vital security and economic interests has been a constant of U.S. strategy. Vital economic interests include unencumbered access to resources and secure commerce. With the disintegration of the Soviet Union, vital security interests are now centered on "shaping the environment," e.g., containment of emerging peer competitors and deterrence of regional aggressors. The general focus of President Clinton's *National Security Strategy* is "engagement and enlargement." *Enlargement* refers to the Administration's policy goal of increasing the number of free democratic societies on the premise that democracies are more likely to trade than fight. *Engagement* is a direct affront to historical isolationist tendencies the United States has manifested following every foreign war and major conflict, and refers to the Administration's stated policy to remain involved in the international arena and to use our position as a world leader to influence events and other governments' policies in a manner that will benefit international stability and our own national interests.

Even in this era of military downsizing, which requires vacating many foreign bases, the U.S. must remain engaged overseas to ". . . deter aggression and advance U.S. strategic interests. Such overseas presence demonstrates our commitment to allies and friends, underwrites regional stability, gains us familiarity with overseas operating environments, promotes combined training among the forces of friendly countries and provides timely initial

³ *A National Security Strategy of Engagement and Enlargement*, The White House, February 1995.

response capabilities."⁴

National Military Strategy

This is a strategy of flexible and selective engagement required to support our Nation's interests. Reflecting the ambiguous nature of our security challenges, the strategy emphasizes full[-]spectrum capabilities for our Armed Forces.

General John M. Shalikashvili
Chairman of the Joint Chiefs of Staff⁵

The *National Military Strategy* identifies two overarching objectives, **promoting stability and thwarting aggression**, and three components of those objectives, **peacetime engagement, deterrence and conflict prevention, and fighting and winning our Nation's wars**, all of which are facilitated by two complementary strategic concepts: **overseas presence and power projection**. Clearly, these two underlying strategic concepts apply to all U.S. armed forces. It is arguable, however, that naval forces, with the proven capabilities of amphibious ready groups (ARGs) and carrier battle groups (CVBGs), are, more often than not, a Commander in Chief's (CINC's) forces of choice for the most likely scenarios in today's threat environment.

Report of the Commission on Roles and Missions

The Commission on Roles and Missions was charged by Congress to "review . . . the appropriateness . . . of the current allocations of roles, missions, and functions among the Armed Forces; evaluate and report on alternative allocations; and make recommendations for changes in the current definition and distribution of those roles, missions, and functions."⁶

⁴ Ibid., p. 9.

⁵ *National Military Strategy of the United States of America* (Washington, D.C.: Joint Chiefs of Staff, February 1995).

⁶ Department of Defense, *Directions for Defense, Report of the Commission on Roles and Missions of the Armed Forces* (Washington D.C.: U.S. Government Printing Office, 1995), p. ES-1.

In general, the Commission reported that the Department of Defense was headed in the right direction, stressing that the Services provide the military capabilities essential to the accomplishment of missions assigned to the Unified Combatant Commands. The Commission specifically identified Service "core competencies," or "the heart of warfighting capabilities," that are essential to unified military operations: ". . . *for the Navy*, carrier-based air and amphibious power projection, sea-based air and missile defense, and anti-submarine warfare; *for the Marine Corps*, amphibious operations, over-the-beach forced entry operations, and maritime pre-positioning."⁷

Naval Strategy

From its inception through the end of the Cold War, the United States Navy's most enduring mission was control of the high seas. Although there were no high seas engagements after the battle of Leyte Gulf, during the final phases of the Second World War, the Soviet threat was enough to keep this mission at the forefront of naval thought, operations and budgetary considerations until the spring of 1991. Even then, generations of naval thought and habits were not about to be changed overnight. The first attempt to codify the "new direction for the Naval Service" came in September of 1992, in the form of the Navy-Marine Corps white paper . . . *From the Sea*.

The concepts in the white paper were fairly bold in direction, quite simple to understand, and, not entirely well-received throughout the Navy.

The world has changed dramatically in the last two years, and America's national security policy has also changed. As a result, the priorities of the Navy and Marine Corps have shifted. . . . Our ability to command the seas in areas where we anticipate future operations allows us to resize our Naval Forces and to concentrate on capabilities required in the

⁷ Ibid., pp. 2-20 (emphasis added).

*complex operating environment of the 'littoral' or coastlines of the earth. . . . Our nation's maritime policies can afford to de-emphasize efforts in some naval warfare areas. . . . The new direction of the Navy and Marine Corps team, both active and reserve, is to provide the nation: naval expeditionary forces; shaped for joint operations; operating forward from the sea; tailored for national needs.*⁸

The next official update of the new naval direction came approximately two years later with the publication of *Forward . . . From the Sea*. It was required because, in point of fact, the Naval Service had not gone forward from . . . *From the Sea*. Priorities had not changed all that much and those warfare areas, such as mine warfare, that were considered children of a lesser god before the collapse of the Soviet Union, were still considered children of a lesser god, despite lessons learned, congressional reports, studies, books and articles that proliferated on mine warfare after the Gulf War. Although undoubtedly representative of a great deal of effort on the part of many, *Forward . . . From the Sea* basically confirmed the fundamentals of . . . *From the Sea* and updated the language to conform to the latest versions of the National Security and National Military Strategies. One unnamed Marine officer was reported to have said, "We had to run hard to stand still."

Next came *Naval Doctrine Publication 1, Naval Warfare*, the first of six Naval Doctrine Command publications intended to "flesh out" and codify modern naval doctrine based on concepts identified in . . . *From the Sea*. The Naval Doctrine Command, established in 1993, was an outgrowth of that milestone document. And, in the February 1995 issue of the *Marine Corps Gazette*, newly appointed Chief of Naval Operations, Admiral J.M. Boorda reiterated and underscored the Naval Service's change in focus.

The 1992 Navy-Marine Corps white paper ' . . . From the Sea' signaled a change in focus and

⁸ Sean O'Keefe, Frank B. Kelso, II, Carl E. Mundy, Jr., . . . *From the Sea, Preparing the Naval Service for the 21st Century*, pp. 2-3.

*priorities. Emphasis on maritime superiority operations gave way to power projection and employment of naval forces from the sea to those regions of the world vulnerable to the striking power of sea-based forces. . . . With the demise of the Soviet Union and the decline of a blue water naval surface threat, we recognized that our challenges were now more likely to be found near and over land.*⁹

There can be little doubt that naval priorities have shifted in the past few years.

Marines generally see this shift as a reconfirmation of the traditional bond between themselves and their amphibious-fleet Navy colleagues, and perhaps an indication that amphibious warfare itself has moved up a few notches in the hierarchy of naval priorities. More specifically, however, Marines realized their own amphibious doctrine was in need of revitalization and updating. *Operational Maneuver From the Sea* (OMFTS) provides doctrinal guidance for a spectrum of contingencies from peacetime military operations to major regional conflicts.

The essence of the guidance is that the Navy-Marine Corps team must be capable of using the operational maneuver space assured by maintaining command of the world's oceans to project power across the littorals to inland objectives, without stopping at a beachhead to build up combat power ashore. This is often referred to as "seamless transition" from deep water to the objective. OMFTS combines freedom to maneuver from the sea with the tenets of maneuver warfare—tempo, momentum, strength against weakness and focus on the strategic objective.¹⁰

In today's security environment, there can be no single overriding priority. Nuclear

⁹ Admiral J.M. Boorda, *The Marine Corps Gazette*, "The Navy Marine Corps Team: Looking Ahead," March 1995, pp. 22-25.

¹⁰ FMFMRP 14-21, *Operational Maneuver From the Sea*, Coordinating Draft, Concepts Branch, Marine Corps Combat Development Command, Quantico VA, March 1996, pp. 1,6.

deterrence has not totally vanished. Non-proliferation of weapons of mass destruction, counter-terrorism, and counter-drug operations are still important considerations in the national security arena. Major regional contingencies remain the primary drivers for planning and procurement and the U.S. is not *necessarily* bound to respond to any crisis with Marines coming from the sea, but it cannot be denied that one consistent thread running from the National Security Strategy down through the National Military Strategy and emphasized repeatedly in Navy and Marine Corps doctrinal guidance, is that expeditionary forces must be capable of projecting combat power from the sea, across the beach to inland objectives throughout the world's littoral regions. Like the warp of a fine carpet, you cannot pull on this thread without feeling the strain throughout the fabric of American national security strategy.

The United States Navy currently has no peer competitor for dominance of the high seas, and barring a reversal of recent Russian policy, that dominance will remain essentially unchallenged for some years to come. Therefore, those naval core competencies associated with naval superiority over deep water oceans of the world are not in question. That is not, of course, to say that traditional naval missions can be ignored. They may need to be re-oriented, re-prioritized and re-focused, but certainly not ignored. Sea lines of communication (SLOC) protection, for example, can now logically be oriented primarily to the terminal end of the logistic chain.

Emphasis has shifted from fighting for dominance of the high seas to selective power projection throughout the world's littoral regions. The capability to move men and material from sea to shore and to conduct opposed amphibious landings are integral parts of that

power projection and therefore national priorities as well as a fundamental naval "core competencies." Yet, the ability to conduct these operations at the time and place of our choosing is in serious jeopardy. Relatively cheap, widely available sea mines offer any nation with a coastline a means of thwarting the most powerful armed forces in the history of the world.¹¹

THE SEA MINE THREAT: From the General to the Specific

We have lost control of the seas to a nation without a Navy, using pre-World War I weapons, laid by vessels that were utilized at the time of the birth of Christ.

Rear Admiral Allan E. "Hoke" Smith
Commander, Amphibious Task Force
Wonsan, Korea, 1950

Sea mines may be employed anywhere there is water. Ports, harbors, sea lines of communication, open oceans, amphibious objective areas, carrier operating areas, rivers, lakes and estuaries are all susceptible to mining. The more important it is for friendly forces to utilize a particular water area, the more likely it is that enemy forces will mine them, assuming they have the resources to do so.

Understanding the Threat

The relatively low cost of mines makes them ideal weapons for any nation with access to the sea, and although recent technology has produced more sophisticated and deadly sea mines, simple World War II vintage mines remain a formidable threat. Widespread availability and ease of deployment by ship, aircraft or submarine, coupled with their

¹¹ Since 93-95% of all warfighting materials usually get to the war via sealift, it is much more than a just a "navy" problem.

physical and psychological force multiplier effects, often make sea mines the weapons of choice of nations throughout the littoral regions of the world, regardless of their economic or political standing within the global community.

The actual or perceived use of mines by a potential adversary poses a significant military problem, and as with any threat, weapon variants and differing employment parameters, profiles and scenarios represent a wide spectrum of risks to friendly forces. The chances of any nation, even a major regional power, effectively mining large expanses of deep, open-ocean waters is minimal. On the other hand, every nation with a coastline is likely to include shallow water mining in any planned defense. To understand the problem and appreciate the differing threat scenarios and risk profiles, it is necessary to have a basic understanding of mines and mining operations.

Mine Classification. Sea mines are usually classified by their position in the water; their method of delivery, or "planting"; and their method of actuation. When classified by *position in the water*, mines fall into three categories:

- * **Bottom mines** are generally used in waters less than two hundred feet. Beyond that depth, they pose much less of a threat to shock-hardened vessels. As their name implies, they lay on the bottom of the ocean (lake, river, etc.) and are normally influence activated. Depending on bottom characteristics, they may become buried, obscured or extremely difficult to detect due to background conditions.

- * **Moored mines** are designed to be effective against submarines and surface ships in deeper water, but may be used in shallow water also. The explosive charge and firing mechanism are housed in a positive-buoyancy case attached to a cable anchored to the

sea bottom. The depth of the water and length of cable determine the preset mooring distance below the surface. Moored mines may be influence, contact or control activated.

* **Drifting mines** float freely on or near the surface due to positive or nearly neutral buoyancy. Although their use was limited by the Hague Convention of 1907, moored mines become drifting mines when their cables fail due to countermeasure efforts, faulty design or old age. Drifting mines (by design) are generally contact actuated.

When classified by *method of delivery*, mines, again, fall into three categories:

* **Aircraft delivered** mines are dropped from aircraft in the manner of bombs and may require some aerodynamic modification to standard casings. This method of delivery offers the advantage of speed. Many mines can be planted in a short period of time. This may be particularly desirable during offensive mining operations.

* **Submarine delivered** mines are specially configured to be launched from torpedo tubes and offer the best method for laying mine fields covertly.

* **Surface delivered** mines may be delivered by any ship or boat. As pointed out by Admiral Smith at Wonsan, old fishing boats can be very effective mine-delivery platforms.

The last, and probably most critical, way mines are classified is by *method of actuation*, and again they fall into one of three categories.

* **Influence mines** are actuated by the magnetic, acoustic, seismic or pressure signatures (or combination thereof) of ships or countermeasures devices. The detector may have one or a combination of magnetic search coils, magnetometers, hydrophones or pressure devices. The detector sends an electrical signal to a firing mechanism that may be

sophisticated enough to analyze the signal to determine if it was generated by a valid target, i.e., a ship of a given size operating within the mine's damage zone. If the preset parameters are met, the firing mechanism initiates the detonation sequence.

Rising mines are a special sub-category of influence mines that may be used in depths of approximately 1000 feet. Using acoustic and/or magnetic sensors to detect a target, the warhead is released from its moored position and then is either propelled or "rises" to the target as it comes within range. More expensive and less widely available, rising mines are nonetheless a serious threat consideration.

* **Contact mines** are the oldest, least expensive and probably most common type of mine. Physical contact between the mine and target is required to detonate the mine, which in turn requires very little sophistication or expense. During operation Desert Storm, a moored contact mine, which probably cost under 1500 dollars, blew a sixteen by twenty-five foot hole in *USS Tripoli's* hull, causing the ship to flood with almost 271,000 gallons of water and resulted in the loss of a major warfighting asset for the rest of the war.

* **Controlled mines** receive firing signals from external control centers. They require monitoring to be effective and are traditionally associated with defensive minefields. The Vietcong, however, deployed crude but effective controlled mines offensively against U.S. river patrol craft and other shipping during the Vietnam War.

In addition, under the context of international law a distinction is made between **armed mines** and **controlled mines**. In this context, the two are defined as follows:

* **Armed mines** are either emplaced with all safety devices withdrawn, or are armed following emplacement, so as to detonate when pre-set parameters (if any) are

satisfied.

* **Controlled mines** have no destructive capability until affirmatively activated by some form of arming order (whereupon they become armed mines).

Additional Problem Variables. Mines are further distinguished by the type of *counter-countermeasures* they incorporate. These measures range from simple mechanical devices designed to cut or foul minesweeping equipment, to different casings or coating materials (such as plastic), to sophisticated target discrimination circuitry or programming. *Multiple sensors* make it more difficult for influence sweepers to fool the mine. *Adjustable sensitivity trigger devices* allow mines to actively target the smaller, yet—for this specific environment—high value, mine sweeper assets. *Ship counts* force mine sweepers to reproduce the triggering signal multiple times to explode the mine, forcing MCM assets to conduct multiple passes which increases both the time and uncertainty of the sweep. *Anechoic coatings, geometric shapes, or encapsulating containers* make it difficult for mine-hunting sonars to both find and classify mines.¹²

To further complicate countermeasures efforts, water depth, tidal range, current, turbidity, salinity, bottom clutter and temperature all affect the ability of friendly forces to detect or sweep mines. These *environmental conditions* are unique for each mine situation and should be considered essential elements of information (EEIs) for the commander. Rocky bottoms, for instance, degrade sonar detection capability. Muddy bottoms may allow

¹² See H. Dwight Lyons Jr., Eleanor A. Baker, Sabrina R. Edlow, and David A. Perin, *The Mine Threat: Show Stoppers or Speed Bumps?* (Alexandria, VA: Center For Naval Analyses, 1993).

mines to become buried and virtually undetectable, except by marine mammals.¹³ Water depth, however, is probably the most critical discriminator when considering the overall risk associated with the mine threat.

Mineable waters may be defined as all ocean, coastal, and inland waterways in which traffic density warrants the use of such weapons. Mineable waters are broken down by depth as follows.

Deep Water—greater than 600 feet

Medium Deep Water—from 200 to 600 feet

Shallow Water (SW)—from 40 to 200 feet

Very Shallow Water (VSW)—from 10 to 40 feet

Surf Zone (SZ)—from the high water mark to 10 feet

Craft Landing Zone (CLZ)—inland from the high water mark

Although modern moored mines can anchor in depths in excess of 10,000 feet and casings (explosives and sensors) are designed to operate in as deep as 1,200 feet, the threat of even a regional power mining medium and deep water, with the notable exception of the approaches to certain strategic straits, is much less than the threat of almost any nation mining coastal and inland waters. Potential adversaries will get much greater return for their investment with relatively cheap, unsophisticated mines designed to operate in water depths of 200 feet and less.

¹³ The Marine Mammal Program, which utilizes specially trained dolphins in a strictly detection role, is a very successful, but somewhat sensitive area of MCM. The care, training and transportation of the dolphins is both expensive and manpower intensive, but they have proven to be the only reliable method of detecting certain buried mines. Additionally, negative reaction from animal rights groups is always a significant consideration, despite the fact that they are extremely well fed, treated and maintained.

Isolating the Most Critical Threats

All mines are potentially dangerous and represent varying degrees of threat and risk to mission accomplishment. There are four interrelated factors, however, that when viewed in combination, greatly aid in defining the magnitude of the mine threat: their potential destructive power; where they can effectively be planted; their susceptibility to countermeasures; and lastly, the mission that requires friendly forces to operate in or near an adversary's mined waters.

All other factors being equal, high-explosive, technologically sophisticated mines represent a greater threat than smaller, less sophisticated mines. But for a fiscally-constrained state, large numbers of cheaper mines represent a better investment (i.e., force multiplier) than fewer, larger, more expensive ones. The modern mine field will likely incorporate a combination of several types and sizes. Not all mines, however, are equally effective in all water zones.

In deep and medium-deep water (below 200 feet), bottom mines are much less effective than in shallow water and only moored and rising mines will generally be used. In very shallow water (10 - 40 feet), bottom mines are usually more effective because they are usually harder to detect. Land mines are normally laid in the surf zone (high water mark to a depth of 10 feet) and all types of sea mines are effective, and should be expected, in the shallow water zone (depths of 40 - 200 feet). Additionally, as a general rule, only smaller and more vulnerable ships and landing craft will be operating in the very shallow water and surf zone, so smaller, less expensive, (and therefore probably more plentiful) mines may be utilized to cause critical damage.

Regardless of where they are located or how potentially damaging they may be, timely, effective countermeasures can negate any mine threat. The discussion, then, evolves to missions versus countermeasures capabilities. If the mission is to conduct daylight, benign environment mine sweeping operations, following the cessation of hostilities, U.S. mine countermeasures capability is excellent.¹⁴ If the mission precedes an opposed amphibious assault, under the tenets and guidelines of . . . *From the Sea* and *Operational Maneuver From the Sea*, then our mine countermeasures capability is severely deficient, particularly in the very shallow water and surf zones.¹⁵

As was demonstrated at Wonsan in 1950, and the Persian Gulf in 1987 and 1991, the area of our greatest naval vulnerability is where the enemy tends to employ his most effective "naval" capability: mines in the shallow water zone through the surf zone. For the Navy and Marine Corps team, this represents a very serious challenge to one of their essential missions and core competencies, the opposed amphibious assault. This fact alone should elevate mine warfare to one of the three or four highest priorities within the Naval Service, but history has proven that maintaining focus and priority on mine warfare is not a easy task.

¹⁴ Scott C. Truver, "Exploding the Mine Warfare Myth," *United States Naval Institute Proceedings*, October 1994, pp. 36-46.

¹⁵ This deficiency has been identified in several studies and articles since the Gulf War, and, of course, many times prior to that. See Lyons, et al., op. cit. in note 12, p. 26.

MINE WARFARE: Narrowing the Focus; Peeling the Onion

. . . I believe there are some fundamentals about mine warfare that we should not forget. Once mines are laid, they are quite difficult to get rid of. That is not likely to change. It is probably going to get worse, because mines are going to become more sophisticated.

Admiral Frank B. Kelso, II, USN
Chief of Naval Operations
October, 1992

One of the reasons that people have trouble maintaining interest in mine warfare is that it is an expansive topic with a great many confusing and sometimes ambivalent facets. Shortly after the Gulf War, one mine warfare analyst wrote: "Don't be fooled by the naysayers; the U.S. Navy's mine countermeasures operations in the Gulf . . . were excellent."¹⁶ But that statement is simply too broad and too general to have any real value. The only major coalition ship damage during the Gulf War was caused by Second World War vintage mines and there is evidence to suggest that fear of mine fields may have prevented a Marine amphibious landing, even if the situation had otherwise warranted it.¹⁷ As at Wonsan, a nation with almost no navy prevented the strongest navy in the history of modern warfare from attaining and maintaining control of the sea, and yet there are positive, although conflicting, reports on how "successful" American mine countermeasure efforts were.

In order to eliminate much of the confusion, that portion of mine warfare that is most critical to maintaining essential naval capabilities must be specifically identified and singled out from other areas of less concern. Before mine warfare requirements can be properly

¹⁶ Truver, op. cit. in note 13, p. 36.

¹⁷ Admiral William J. Crowe, Jr., *The Line of Fire* (New York: Simon and Schuster, 1993), p. 326. "The reason we did not mount an amphibious operation against Kuwait during the Gulf War was primarily the mine threat."

prioritized among other warfare specialty requirements, they must be prioritized within the mine warfare specialty itself. Mine warfare is not a monolithic entity, and each facet and branch has its own interests and internal champions. Not all parts, however, are equally important to critical naval capabilities. It is fundamentally important, therefore, to understand all the different elements of mine warfare and peel them back until the most critical areas are exposed.

Mine Warfare

Mine warfare is the strategic and tactical use of sea mines and their countermeasures, and encompasses the total capability of laying, using, locating and neutralizing mines. As with other warfare specialties, mine warfare includes both the protection and use of one's own capabilities and the defeat of the enemy's. The emplacement of mines is called **mining**. Countering enemy mining is termed **mine countermeasures**.

Mining. Mining can be offensive in nature when utilized to attack enemy ships in transit or bottle them up in their own waters. It can also be employed defensively to guard selected waters from enemy intrusions. Modern mines can be extremely sophisticated and effective weapons, with complex algorithms and software allowing them to select targets and resist countermeasures. The specific focus of modern mine warfare, though, is to effect sea control, with the secondary mission of neutralizing or destroying enemy shipping. Mining issues, while important, are significantly less crucial to maintaining critical naval capabilities (articulated in . . . *From the Sea and Forward* . . . *From the Sea*) than are mine countermeasures issues. Although there have been times when increased mining capability might have proved beneficial, there are no historical examples of the United States Navy

being significantly impaired due to the lack of mining capability. The same cannot be said for the lack of mine countermeasure capability.¹⁸ This is the first major division of focus within mine warfare and although there are areas of technology and information where the two major categories intersect, the point of effort must remain with mine countermeasures.¹⁹

Mine Countermeasures (MCM). MCM include all methods for preventing or reducing damage or danger from mines and may be either offensive or defensive in nature and active or passive in character. Additionally, mine countermeasures efforts are classified according to the depth of water in the operating area as well as the specific MCM operation. Again, depending on the operational situation, not all facets and areas within MCM are equally important in terms of protecting critical naval capabilities, but they must all be thoroughly understood in order to effectively prioritize efforts within the general category of MCM.

Offensive MCM. Sometimes referred to as anti-mining operations, offensive MCM includes those actions taken by friendly forces to destroy enemy mines and/or mining capability before the mines are actually deployed. As Admiral Frank Kelso pointed out, once they are in the water, mines are difficult to remove or neutralize. The most proven and effective method of defeating enemy sea mines is to destroy them before they get in the water. Attacking mine storage areas, detonation control centers, ground transport assets and mine layers (i.e., ships, aircraft and submarines) are currently the most reliable methods of

¹⁸ See Melia, op. cit. in note 1.

¹⁹ For more information on mining see Hartman and Truver, op. cit. in note 2.

defeating the mine threat. While admittedly complex, whenever possible, rules of engagement and prehostility rhetoric should be specifically designed to keep this preemptive option open.

Defensive MCM. Once sea mines are deployed, actions and operations to protect friendly assets and personnel are generally defensive in nature. Although MCM assets are most often at the point of offensive operations, they are defending the fleet from enemy weapons. Defensive MCM (as a sub-category within MCM, which is a sub-category within mine warfare) may be a potentially confusing term, because it certainly contains some "offensive" facets. The division is a necessary one, however, because it helps isolate the most critical areas within mine warfare. As with the division between mining and mine countermeasures, one path is much more important to maintaining critical naval capabilities. In this case it is defensive MCM. Offensive MCM is a matter of political authority and rules of engagement, and the decision for such operations is usually made by the National Command Authorities (NCA). Militarily, the capability to conduct offensive MCM is resident within current naval and joint forces as opposed to defensive MCM capabilities, which have significant shortfalls, many of which remain unresolved.

Defensive MCM is further divided into passive and active measures.

* Passive Measures, usually associated with surface vessels, are overtly defensive in nature. Passive measures include:

** Mine watching—human or electronic surveillance to determine where mines are laid.

** Mine avoidance—marking mined areas and/or rerouting traffic around

suspected mined waters.

**** Deperming**—demagnetizing a hull by electrical current, reducing magnetic fields by external application.

**** Degaussing**—reducing a ship's magnetic signature through installation of permanent on board equipment.

**** Noise reduction**—installing noise reduction features, or establishing procedures to reduce the likelihood of a ship actuating an acoustic mine.

**** Ship protection**—employing a wide range of human, mechanical and electronic options to protect a ship from mines. Nets, booms, bow watches, torpedo catchers and rakes (like early train cow catchers) are some less sophisticated examples. More high tech examples include bow mounted paravanes, mine avoidance sonars, and damage-resistance designs.

*** Active measures** generally involve actions taken by MCM forces at the tactical level to locate and neutralize mines or deceive them into detonating on a false target. Active measures include:

**** Mechanical minesweeping**—utilizing specifically designed and/or equipped ships or helicopters singly, or in pairs, towing buoyed sweep gear to mechanically cut mooring cables, which allows mines to surface and be neutralized. Other forms of mechanical sweeping involve bottom trawling and using plows and rakes attached to tracked amphibious vehicles for clearance in the surf and beach zone. Although the most common and best known form of MCM, involving ships, amphibious vehicles and helicopters, mechanical sweeping remains limited in scope, time consuming and hazardous.

**** Influence minesweeping**—creating false signatures to produce magnetic, acoustic, pressure, or other influences needed to explode mines.

**** Minehunting**—searching for mines.

**** Mine disposal**—physically neutralizing mines by sympathetic explosion, gunfire, deactivation, placed charges or physical removal.

**** Countermining**—a specific form of mine disposal involving under water charges placed by divers or remotely operated vehicles (ROV), not to be confused with "countermine operations" associated with offensive MCM.

All defensive mine countermeasures have advantages and disadvantages, and the discussion over what MCM assets, or what "suite" of options need to be promoted ahead of others is an ongoing battle, with no apparent end in sight.²⁰ The discussion needs to be centered around critical capabilities required by today's naval forces to prosecute current doctrine. Thus far the focus has been narrowed from mine warfare in general to mine countermeasures, to defensive mine countermeasures. To continue peeling the onion and correctly focus on the most crucial active and passive countermeasures, this discussion must be linked directly to an assessment of the threat.

As stated earlier, the threat is predicted on four factors: the mines, the countermeasures, the water zone and the mission. Deep water missions are generally at lower risk from a mine threat because extensive areas of open ocean cannot be effectively mined, and only uncontrollable, drifting mines and expensive rising and moored mines are

²⁰ For an indepth discussion on active and passive mine countermeasures and their strengths and weaknesses see: *Mine Countermeasures Technology Volume II*, National Academy of Sciences, (Washington D.C: National Academy Press, 1994) (Secret)

effective in waters over 200 feet.

As a general rule, mines represent the greatest threat in waters less than 200 feet because that is the area where the greatest number of mines are most likely to be effectively employed, and where power projection missions will most likely require that U.S. forces operate. Not surprisingly, this is the area where all defensive, active mine countermeasures are designed to be most effective. Given the current state of threat/counter threat technology, countermeasures effectiveness in this area is a function of time and risk. Given enough time in a protected or benign environment, current MCM assets can reduce the risk to near zero. MCM operations, however, are by their very nature, painstakingly deliberate, extremely vulnerable, and for air MCM, limited to daylight only. Obviously, the more risk a commander is willing or is able to accept, the less time required, or allowed, for MCM operations.

Given the tenets of *Operational Maneuver from the Sea*, particularly "overwhelming tempo" and the demand for an ability to apply sustainable force to a critical center of gravity faster than the enemy can effectively counter, this could very well be a limiting factor in conducting a "seamless" transition from deep water to the objective. There are two other water zones, however, that represent an even more pressing problem: the very shallow water zone and the surf zone. Most air, surface and sub-surface MCM assets are designed to operate in 40 or more feet of water. Therefore, the weakest link in the chain of capabilities, from deep water to the shore, is the last 40 feet.²¹ Explosive Ordnance Disposal divers and

²¹ This is not a new or overly argumentative conclusion. Several studies and reports have identified the problem. Lyons, et al., op. cit. note 12, p. 26, says it most directly. The final section prior to summary and conclusions is titled: "Lanes to the beach: a problem we have not solved—yet."

SEALs can provide covert reconnaissance and limited clearing, but it is a very slow and hazardous operation, usually confined to a very limited area.

Once again, in selecting priorities and maintaining focus, no area of mine warfare can reasonably be classified as unimportant. The problem is one of prioritization, and *the area of greatest importance* is that area where *least capability* intersects with *greatest threat to critical naval missions and core competencies*. *That area is active defensive mine countermeasures in the very shallow water through the craft landing zone.*

CONCLUSIONS: Focus and Priority

The Navy's *Mine Warfare Plan*²² provides an excellent overview of the mine warfare problem and recent advances, current assets and ongoing projects. But, as one would expect from this type of high-level document which covers all aspects of the subject, the *entire* program was emphasized as opposed to separating out individual areas of concern. The same is true for other major studies and reports cited in this paper. The mine warfare problem is, in fact, composed of many separate, yet intricately interwoven parts, and there is always a danger in focusing too narrowly on one area at the expense of the whole.

The purpose of this paper, however, is to focus and prioritize. Limited defensive, active, mine countermeasures in the shallow water zone is a definite traffic barrier in the projection of power ashore. Whether or not it slows down operational maneuver from the sea to an unacceptable degree is a question of acceptable risk and other mission parameters.

²² *U.S. Navy Mine Warfare Plan*, Second Edition, Fiscal Year 1994-1995 Programs. Published by the Director, Expeditionary Warfare (N85).

Limited mine countermeasures capability remains a constant to be factored into each problem on a case by case basis. Once into the very shallow water zone, however, a lack of defensive, active mine countermeasures, in most cases, represents a true "show-stopper" for opposed, over-the-beach amphibious assaults.

From a *National Security/National Military Strategy* perspective this identified MCM limitation represents a significant reduction in power projection options available to the NCA and the CINC. From

THE AREA OF GREATEST IMPORTANCE IS THAT AREA WHERE LEAST CAPABILITY INTERSECTS WITH GREATEST THREAT TO CRITICAL NAVAL MISSIONS AND CORE COMPETENCIES. THAT AREA IS ACTIVE DEFENSIVE MINE COUNTERMEASURES IN THE VERY SHALLOW WATER THROUGH THE CRAFT LANDING ZONE.

a *Naval Doctrine* perspective it means the Navy-Marine Corps team cannot do everything they say they must, and this means the loss of at least one "core competency" for the joint force commander. There are no such identified limitations in other major warfare areas, but it would be roughly analogous to a carrier battle group not being able to defend itself against a known and common anti-air threat.

MCM deficiencies have been identified in several major studies and reports, and attention is being directed at the problem. The real question is whether that attention is commensurate with the magnitude of the problem and whether or not that effort is being directed, first and foremost, at the most critical areas of concern. There are many initiatives and promising technologies under consideration,²³ but the question still remains of whether

²³ See the National Academy of Sciences *Mine Countermeasure Technology Volume II*, "Bold Approaches." (Secret)

or not the U.S. is in another "deja vu" cycle. It would not be the first (or even the second or third) time that promising programs were sidetracked due to waning interest.

The only way to prevent that from happening again is to make certain that the link between critical MCM capabilities and national priorities is bluntly articulated and well understood within the Navy and Marine Corps, the other armed forces and the rest of the national security community. Only then will there be any assurance that the mine warfare problem will receive the sustained focus and priority requisite to solving the problem.

Considering the current aversion for casualties of the American people, the United States Navy and Marine Corps will most likely be unable to **fully** prosecute the tenets of . . . *From the Sea* and *Operational Maneuver From the Sea* until the shallow water, very shallow water and surf zone mine countermeasures problem is solved. That statement, while extremely argumentative, must be recognized by the Naval Services and others if progress is to be made. This is not just a "naval" problem; it is a national security problem and will only be solved with sustained national-level focus and priority.

The first step in solving any problem is to correctly define it. If we insist that the mine countermeasures problem does not *really* endanger our capability to perform critical missions, the problem will undoubtedly linger another 130 years.

APPENDIX A

Recent Developments in Mine Countermeasures

While the primary thrust of this paper may justifiably be perceived to be a negative reflection on the efforts being put forth to correct known deficiencies in Mine Countermeasures capabilities, especially in view of the importance of MCM to the successful execution of naval expeditionary warfare, it must be pointed out that there are several positive developments that hopefully are indicative of a budding transition in cultural naval attitudes about the priority MCM receives in warfare considerations. The intent is not to point out a current lack of interest in improving MCM capabilities because there is, in fact, a great deal of interest in that area. Instead, the intent is to frame the historic cycle of disinterest that we have witnessed with respect to the end of any hostilities where MCM shortcomings were a factor. The following are important examples of recent developments which may signal the end of this cycle, at least to some degree.

*** Renewed interest and investment on organic mine reconnaissance systems.**

Previously considered to be almost exclusively within the domain of antisubmarine warfare, a great deal of effort is now being expended on Unmanned Underwater Vehicles (UUVs) and how the concept can apply to MCM. Ranging from the Autonomous Legged Underwater Vehicle (ALUV), a crab-like robot being developed by Rockwell International that would carry locating sensors as well as explosives to detonate any mines found in the surf zone, to the non-autonomous, tethered UUVs and acoustically guided UUVs that would be directly guided from a controlling platform, research into these various capabilities is forging ahead

at a rapid pace. While the research is promising and technologies have improved enough to make the concepts operationally viable, it remains to be seen whether the funds will be made available in order to make the concepts a reality. Additionally, the following systems are under development:

- AQS-20. Airborne towed minehunting sonar, a significant upgrade to AQS-14 sonar previously in use.
- MCAC (Multi-purpose Craft Air-Cushion). Enhancement to LCAC air cushion amphibious craft that gives it the capability to hunt and sweep mines.
- ALMDS (Airborne Laser Mine Detection System). Designed to use lasers to detect mines from helicopters.
- RMOP (Remote Minehunting Operational Prototype). Also known as DOLPHIN, the system is a prototype of a semisubmersible unmanned undersea vehicle that can be configured for deployment from surface ships as a remote minehunting vehicle. The system has successfully completed operational testing at the Coastal Systems Station in Panama City, Florida, and is currently in the process of being fleet tested.

*** Renewed emphasis on improving prestige and professional image of personnel involved in MCM.** Several steps have been taken by Navy personnel policymakers to improve the image and enhance the professionalism of those officer and enlisted personnel involved in MCM. Navy Enlisted Classification Codes have been created that identify those enlisted personnel who have established experience and expertise in MCM operations and

technology. It has long been recognized that officer career development could actually be "sidetracked" to some extent by MCM experience, especially in the surface warfare community, since the expertise gained did not contribute to the "more acceptable" warfare skills traditionally expected of a young officer. Some efforts have been made in various official policy statements, authoritative pronouncements in professional journals and to selection board members to eliminate the cultural disadvantage that has traditionally plagued those officers whose experience has been in the MCM vice the "more acceptable" warfare specialty areas. Cultural hurdles are particularly difficult to overcome in the naval service, and it remains to be seen how effective these efforts will be or how long it will take for them to be successful.

*** Organizational changes designed to enhance the effectiveness of future MCM efforts.** The relatively recent creation of the OPNAV Expeditionary Warfare Division (OPNAV N-85) headed by a Marine Corps general, and that division's ownership of the programmatic issues involved in MCM, will conceivably aid in maintaining a more successful focus on MCM, eliminating the previous tendencies for MCM issues to get diluted among the perceived "more pressing" budgetary priorities involving the higher visibility warfare areas. This new OPNAV division forms one leg of a triad which also includes Commander Mine Warfare Command (COMINEWARCOM) located in Corpus Christi, Texas, established as the Navy's mine warfare "center of excellence." COMINEWARCOM's responsibilities include ensuring the material readiness of mine warfare elements, conducting operational training and exercising command of mine warfare

forces when deployed. Additionally, COMINEWARCOM serves as advisor to OPNAV (N-85). The third leg of the triad is the technical one. During the recent reorganization, the Secretary of the Navy established a Program Executive Office for Mine Warfare-PEO (MIW) within the Office of the Assistant Secretary of the Navy (Research, Development and Acquisition) (ASN/RDA) to oversee the numerous mine warfare programs that are under development and frequently cross several funding categories and warfare areas. Normally an Engineering Duty Officer admiral, PEO (MIW) reports directly to ASN/RDA with appropriate coordination with OPNAV and Headquarters Marine Corps staffs.

In addition, a new initiative has been launched to establish a unit designed to help counter the very shallow water mine threat. Composed of the Navy's Sea Air Land (SEAL) commando teams, EOD teams and Marine reconnaissance units, the new unit would be based in Coronado, California.²⁴

²⁴ Holzer, Robert, "Navy Urges Mine Warfare Fund Hike" *Defense News*, (February 5-11, 1996), p. 10.